PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.:	10/650,208
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Applicant:	Andrew W. Phillips
Group Art Unit:	3683
Examiner:	Lan Nguyen
Title:	THERMAL SIMULATION FRICTION DEVICE COOLING CONTROL
Attorney Docket:	GP-302782-PTT-CD

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

AMENDMENT

Sir:

In response to the Decision on Appeal mailed June 27, 2008, please amend the application as follows and consider the remarks set forth below. A Request for Continued Examination (RCE) is submitted herewith.

Amendments to the Claims begin on page 8 of this paper.

Remarks begin on page 8 of this paper.

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (Currently Amended) A cooling system for cooling a friction device, comprising:

a flow control device that controls a flow of cooling fluid through said friction device; and

a controller that estimates [[a]]at least one temperature state that includes a bulk friction device temperature of said friction device based on an estimated heat rate of said friction device, calculates a flow command based on said temperature state and operates said flow control device based on said flow command.

2. (Cancelled).

3. (Previously Presented) The cooling system of claim 1, wherein said controller determines a friction device torque and a friction device slip speed and calculates said heat rate of said friction device based on said friction device torque and said friction device slip speed signal.

4. (Previously Presented) The cooling system of claim 1, further comprising:

a sump for collecting said flow of fluid; and

a sump temperature sensor that generates a sump temperature signal, wherein

said temperature state is further based on said sump temperature signal.

5. (Previously Presented) The cooling system of claim 1, wherein said temperature state is further based on a current flow command.

6. (Previously Presented) The cooling system of claim 1, wherein said flow command is further based on said heat rate of said friction device and a sump temperature of said flow of fluid.

7-8. (Cancelled).

9. (Original) The cooling system of claim 1, wherein said temperature state is a thermal energy of said friction device.

10. (Currently Amended) A method of controlling cooling of a friction device, comprising:

estimating a temperature state <u>of a component</u> of said friction device based on an estimated heat rate of said friction device;

calculating a flow command based on said temperature state; and

controlling a cooling fluid flow through said friction device based on said flow command.

11. (Cancelled).

12. (Previously Presented) The method of claim 10, wherein said heat rate is based on a friction device torque and a friction device slip speed.

13. (Previously Presented) The method of claim 10, further comprising measuring a temperature of said fluid flow, wherein said temperature state is further based on said temperature.

14. (Previously Presented) The method of claim 10, wherein said temperature state is further based on a current flow command.

15. (Previously Presented) The method of claim 10, wherein said flow command is further based on said heat rate of said friction device.

16. (Previously Presented) The method of claim 10, wherein said flow command is further based on a temperature of said fluid flow.

17-18. (Cancelled).

19. (Previously Presented) The cooling system of claim 10, wherein said temperature state is a thermal energy of said friction device.

20. (Currently Amended) A method of controlling cooling of a friction device,

comprising:

calculating a heat rate of said friction device;

estimating a temperature state <u>that includes a bulk temperature </u>of said friction device based on said heat rate;

determining a flow command based on said temperature state; and

operating a flow control device based on said flow command to control a cooling fluid flow into said friction device.

21. (Original) The method of claim 20, further comprising:

determining a friction device torque; and

determining a friction device slip speed, wherein said heat rate is based on said friction device torque and said friction device slip speed.

22. (Original) The method of claim 20, further comprising measuring a temperature of said fluid flow, wherein said temperature state is further based on said temperature.

23. (Previously Presented) The method of claim 20, wherein said temperature state is further based on a current flow command.

24. (Previously Presented) The method of claim 20, wherein said flow command is further based on said heat rate and a temperature of said fluid flow.

25. (Cancelled).

26. (Previously Presented) The method of claim 20, wherein said temperature state is a thermal energy of said friction device.

27-29. (Cancelled).

30. (New) The cooling system of claim 1 wherein said temperature state is based on thermal inertia of said friction device.

31. (New) The cooling system of claim 1 wherein said temperature state is based on heat rejection of at least one of said friction device and said cooling system.

32. (New) The cooling system of claim 1 wherein said temperature state is based on a loop time of a thermal model of said friction device.

33. (New) The cooling system of claim 1 wherein said temperature state is based on a thermal module according to $T_{Cderiv} = \left(\frac{1}{M_{clutch}}\right)\left(H_R - K_{diss}\left(T_C - T_{sump}\right)\right)$, where T_{Cderiv} is a derivative of said temperature state, M_{clutch} is thermal inertia of said friction device, H_R is said heat rate, K_{diss} is heat rejection of said friction device, T_C is said temperature state and T_{sump} is a sump temperature.

34. (New) The cooling system of claim 1 wherein said temperature state is based on a thermal model of said friction device, and

wherein said thermal model performs as a low-pass filter.

35. (New) The cooling system of claim 34 wherein said low-pass filter tracks $\frac{H_R}{K_{diss}} + T_{sump}$, where H_R is said heat rate, K_{diss} is heat rejection of said friction device, and T_{sump} is a sump temperature.

36. (New) The cooling system of claim 35 wherein said low-pass filter tracks $\frac{H_R}{K_{diss}} + T_{sump}$ with a time constant of $\frac{M_{clutch}}{K_{diss}}$, where M_{clutch} is thermal inertia of said friction device.